December 23, 2003 | WCAP-16180-NP, Rev. 0
WOG-03-643 | Project Number 694

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Attention: Chief, Information Management Branch,
Division of Program Management

Subject: WOG CE Fleet Operability Assessment Regarding Pressurizer Heater Sleeves

Reference: WOG-03-610, Westinghouse Owners Group Activities to Address CE Plant Pressurizer Heater Sleeve Degradation Issues, November 19, 2003

Attached please find Westinghouse topical report WCAP-16180 (Non-Proprietary), "Operability Assessment for Combustion Engineering Plants with Hypothetical Circumferential Flaw Indications in Pressurizer Heater Sleeves." Submittal of this report is not for the purpose of NRC review and approval, but rather is being provided to keep the Staff informed of the results of the Westinghouse Owners Group (WOG) evaluations of the pressurizer heater sleeve cracking issue. This report provides (1) the basis by which continued safe operation is demonstrated for the Combustion Engineering (CE) fleet of plants, and (2) plans to enhance the inspection methodology that will be applied by the CE plants going forward. This submittal fulfills the commitment made to the NRC during the November 3, 2003 telephone discussion between the WOG and the NRC, and reiterated in our referenced status letter of November 19, 2003 and discussed with you on December 12, 2003.

The attached Operability Assessment has been developed by the WOG to address the pressurizer heater sleeve circumferential cracking issue. The Operability Assessment represents an analytical program designed to evaluate the potential for a heater sleeve ejection incident and evaluate the effects of such an occurrence on plant design basis analyses. This program is applied in conjunction with the heater sleeve inspection programs put in place by each utility to demonstrate that the CE fleet of plants can continue to be safely operated while the long-term resolution of the heater sleeve cracking issue is developed and implemented.

As a brief background, pressurizer heater sleeve leakage was first identified in the late 1980's, and was identified as the result of degradation of the Alloy 600 heater sleeve material. Since that time, comprehensive evaluations of the issue of Alloy 600 degradation have led to effective programs for managing the degradation of Alloy 600 small bore nozzles. Until recently, Non-Destructive Examinations (NDE) of leaking heater sleeves had revealed that the flaws were axially oriented. However, in the course of repairing heater sleeves at one CE unit (Palo Verde), NDE discovered circumferentially oriented indications. Additional NDE at that unit confirmed the existence of circumferentially oriented flaws in five heater sleeves. The significance of circumferentially oriented flaws is that if the flaw is allowed to grow, it can reach the critical flaw length and result in a sleeve separation. If such a flaw was

D048

below the heater sleeve to pressurizer shell attachment weld, an ejection of the heater sleeve could occur, with a resulting loss of reactor coolant. The circumferential flaws found thus far have been above the attachment weld, and thus did not represent a breach of the pressure boundary.

Because of the potential safety significance of circumferential cracks, the WOG initiated an effort to develop an Operability Assessment for the CE plants shortly after inspection results from the aforementioned CE unit indicated the possible existence of circumferentially-oriented flaws in the pressurizer heater sleeves. This Operability Assessment supports the following conclusions for the plants in the CE fleet:

- Current visual inspection practices applied to the pressurizer heaters sleeves will reveal degradation flaws well before they become safety-significant.

- Combustion Engineering plant design basis safety analyses bound the consequences of potential ejection of a pressurizer heater sleeve. The incremental contribution of such an event to the core damage frequency is negligible.

The focus of the Operability Assessment is in three primary areas: 1) pressurizer heater sleeve fabrication review, 2) effects of a heater sleeve ejection event on plant operation, and 3) pressurizer heater sleeve integrity evaluation.

<u>Fabrication Review</u> – An extensive report on fabrication history and material properties of every heater sleeve in all of the CE plants was prepared in 1989 as part of the initial efforts to address the heater sleeve cracking issue. A summary of this fabrication and materials information is presented in the Operability Assessment. In addition, a detailed materials and fabrication process records review was performed for the Palo Verde units following the discovery of the circumferential cracks. The results of this review are also included in the Operability Assessment. The review of the Palo Verde heater sleeve fabrication processes and materials properties records concluded that there were no induced conditions that would have increased the potential for circumferential flaw indications. These conclusions are applicable to all other CE plants.

<u>Plant Operational Impacts</u> – An assessment of the potential effects of a heater sleeve failure and ejection on plant operation has been performed. This assessment addresses the effect on ECCS performance, as well as the structural consequences of a small break LOCA, such as missile generation, jet impingement and compartment pressurization. The adequacy of existing emergency operating procedures to allow operators to respond to a heater sleeve ejection event has been reviewed. The potential effect on core damage frequency and large early release frequency was also assessed. The assessment of potential effects on plant operation, which is applicable to all CE plants, concludes that existing design analyses would remain bounding in the event of a pressurizer heater sleeve ejection. The guidance provided in existing plant operating procedures would provide adequate operator direction to mitigate such an occurrence.

<u>Integrity Evaluation</u> – Finite element welding residual stress analyses have been performed for small and large diameter heater sleeves and the geometries with the highest residual welding stress to address the complete range of domestic CE pressurizer heater sleeve designs. Using these results, the growth rate of a through-wall circumferential crack has been calculated, using the methodology recommended by the NRC for closure head nozzles (MRP 55, Rev. 1). A leakage crack resulting in a conservative leak rate, i.e. one that could be readily detected by the current inspection practices, has been postulated. The time for this postulated leakage crack to reach the limiting size to prevent net section collapse (ejection) has been determined.

Using conservative combinations of the limiting material yield stresses and limiting heater sleeve locations on the bottom head, the time for a detectable leakage crack to grow to a critical flaw size that may result in heater sleeve ejection is calculated to be 7.5 years. The initial leak rate (30°) for the detectable leakage crack upon which the calculated growth time is based ranges from about 0.3 gpm to 0.5 gpm (120°), depending on heater sleeve size. Based on the currently implemented visual inspection programs, the calculated time to sleeve ejection provides sufficient margin to demonstrate continued integrity of the pressurizer heater sleeves.

Since the onset of leaking heater sleeves in 1987, CE utilities have been performing visual inspections of the pressurizer bottom head per the Combustion Engineering Owners Group (CEOG) guidance at that time. These visual inspections have proved to be effective at detecting heater sleeve leakage, and at leakage rates significantly less than the leak rates assumed necessary for detection in the integrity evaluation. Further, experience with previous leaking heater sleeves has shown that the leakage has been detected before any corrosion damage to the pressurizer base metal has occurred.

The CE utilities have been conducting visual inspections of the heater sleeves and pressurizer lower head region. Based on the calculated time of 7.5 years for a leakage crack to grow to a size that could result in an ejected heater sleeve, and recognizing that these inspections are performed at each refueling outage, it would take several fuel cycles for a leakage crack to reach critical crack size. Even assuming a maximum fuel cycle of 24 months (most plant fuel cycles are 18-20 months), there would be multiple opportunities for the detection of a leakage crack. This provides added assurance that a crack would not grow to failure before it could be detected and repaired. In addition to the CE fleet current inspection practices, the WOG has also compiled information describing future inspections and plans to repair or replace pressurizer heater sleeves at each plant. This information is included in the Attachment to this letter.

We appreciated the opportunity to discuss the direction of future activities in our telephone discussion on December 12, 2003, and we share your view that the current inspection practices need to be expanded going forward. The WOG has formulated recommendations for expanded inspections that the CE plants are in the process of reviewing. The recommendations include actions to ensure that visual inspections are effective for the earliest detection of extremely small leaks and also provide the means to characterize cracks so as to assist in the optimization of long-term resolutions:

- Perform a bare metal visual inspection of all pressurizer heater sleeve locations at every refueling outage in such a way that visual access to the bare metal, 360 degrees around each sleeve, can be attained (Fort Calhoun Station is replacing their pressurizer in the 2006 refueling outage and will perform the heater sleeve inspection as described in the attachment during the 2005 refueling outage).

- Perform a non-destructive examination (NDE) capable of characterizing crack orientation of all sleeves for which visual inspection shows evidence of leakage. The NDE will be performed no later than the refueling outage after the repair is completed.

Following the CE fleet review of these expanded inspection recommendations, the WOG will provide to you any updates to the inspections the CE plants plan to implement in the future. We expect to communicate this information to you by January 30, 2004. The updated plans will specifically address the inspections that are planned for the spring 2004 outages.

To summarize, the evaluations presented in the Operability Assessment (WCAP-16180), in conjunction with the visual inspection programs currently being conducted each refueling outage at each plant, support the conclusion that continued safe operation of the plants in the CE fleet is assured. Further, application of the expanded inspection program would provide even more assurance that incidents of small leakage will be detected before any significant leakage can develop, or in the case of circumferential cracking, well before a heater sleeve ejection event could occur. The CE utilities are continuing to work toward development of the necessary actions that will ultimately eliminate this issue from long-term consideration for the CE fleet.

We look forward to meeting with the NRC at your earliest convenience to discuss the Operability Assessment and inspection program.

Sincerely yours,

Frederick P. "Ted" Schiffley, II
Chairman, Westinghouse Owners Group

Attachment: (1)

Enclosure: WCAP-16180-NP, Rev. 0

cc: Dr. Brian Sheron, NRC
Drew Holland, NRC
Alex Marion, NEI
Dave Mauldin, APS
Materials Subcommittee
Executive Committee
Steering Committee

Attachment 1
CE Plant Pressurizer Heater Sleeve Inspection Information

Executive Summary

The Combustion Engineering plant operators have used visual inspections to identify the onset of pressurizer heater sleeve leakage following the identification of 20 leaking heater sleeves in 1989. At that time, the safety concern associated with heater sleeve leaks was wastage of the pressurizer lower head material since the observed cracking was axial, slow to propagate, and stable. To manage the safety concern associated with wastage, the frequency of visual inspections was addressed using a mocked up heater sleeve corrosion test. That work was sponsored by the Combustion Engineering Owners Group (CEOG), Task 700[1], and concluded that wastage corrosion of the base material around a heater sleeve would not exceed the ASME Code reinforcement limit for 4.83 years (1764 days). The volumetric corrosion rate was increased by 50% and margins were added to allow inspections to be performed with insulation in place, provided that gaps exist to allow partial visual access to the pressurizer bottom head. The recommended inspection frequency was reduced to 1100 days to allow for evidence of leakage to be observable through the gaps in the insulation. CE plants perform a visual inspection at every refueling outage, a frequency that is significantly less than 1100 days. This inspection frequency has been effective at identifying heater sleeve leakage early in CE plants before any wastage has occurred.

The Operability Assessment (WCAP-16180), which considers the potential for a circumferential crack in the heater sleeve, concludes that it would take 7.5 years for a circumferentially oriented leakage crack in the pressure boundary (i.e. a crack below the heater sleeve to pressurizer lower head weld) to grow to the point of heater sleeve ejection. During that time, the flaw would result in leakage through the clearance fit annulus and would be easily identifiable with current visual inspection practices. Visual inspections would be performed three to five times during this postulated period of crack growth, providing multiple opportunities to identify the leakage. Therefore, the current visual inspection methodology and frequency support the Operability Assessment for both postulated axial and circumferential leakage. The Operability Assessment also considered leakage rate from the growing crack. These results showed that although the leakage rate remains below the technical specification limit of 1 gpm, a leak rate of between 0.3 to 0.5 gpm would be predicted from a circumferential flaw extending ~120° around the circumference of the sleeve, which is well below the critical flaw size of ~320°. This leak rate would be considered significant and cause for investigation in light of the lessons learned from Davis Besse. This leak rate would be detectable as boron deposits with the current visual inspection program, as well as the plant procedures and systems for monitoring RCS inventory.

The CE plant member utilities of the Westinghouse Owners Group (WOG) also recognize that long-term resolution of the Alloy 600 pressurizer issues is necessary. Some of these utilities have already implemented mitigation and replacement solutions that include penetration replacement with Alloy 690 nozzles (two plants completed), nickel plating of the heater sleeve bore adjacent to the weld (two plants completed), and pressurizer replacement (one plant scheduled). Going forward, all utilities are evaluating the effectiveness of mitigation strategies already applied, as well as future options to provide safe and reliable operation of the pressurizer

[1] CE NPSD-690-P, "Evaluation of Pressurizer Penetrations and Evaluation of Corrosion after Unidentified Leakage Develops CEOG Task 700", January 1992.

components. A plant by plant summary of inspections, past mitigation and repairs, and pressurizer replacement plans as of this date are provided in Table 1.

To provide defense-in-depth and additional assurance that any through-wall cracks would be identified long before structural integrity margins would be challenged, the WOG member utilities who own Combustion Engineering NSSSs plan to perform visual inspections of all pressurizer and loop piping small bore Alloy 600 J-groove welded locations every refueling outage. The visual inspections would include examination of the bare metal alloy or carbon steel adjacent to the heater sleeve of small-bore nozzle. In all cases this would include either insulation removal or observation of the bare metal surface through gaps in the insulation such that visual access is achieved 360° around each nozzle. In order to gather further information to support the Operability Assessment assumptions, CE utilities plan to perform NDE inspections (UT or ECT) of any new leaking pressurizer heater sleeve penetrations within one refueling cycle following identification of the leak. The objective of the examinations will be to determine the location, orientation, and extent of PWSCC type degradation. If a welded repair is performed, the examination will be conducted prior to the repair. If a mechanical repair is performed (e.g., Mechanical Nozzle Seal Assembly), then the examination may be performed during the following refueling outage. Additional inspections of the heater sleeve penetrations are encouraged during normal maintenance replacement of the heaters.

Survey of Heater Sleeve Inspection Practices and Future Plans
Since the presence of circumferential cracks was recently confirmed in the pressurizer heater sleeves at one CE plant, the possibility exists that other CE plants might also have this condition and prompted the WOG to develop an operability assessment for all CE plants. The premise to demonstrate the operability of CE plants with this potential condition is to show that cracks can be detected several years before they become safety-significant and repairs can be made.

Early detection relies on the frequency and method(s) of heater sleeve inspections. To support the operability assessment, specific pressurizer heater sleeve inspection information was solicited from all CE plants. The WOG conducted a survey of all CE plants to determine the answers to the following questions:

- What visual or NDE inspections have you performed on your pressurizer heater sleeves? Please include method(s) used, whether insulation was removed or not, and how any bare metal inspections were performed (direct visual access, boroscope, other).
- What are the plans for performing future inspections (please indicate when you plan to perform your next heater sleeve inspection, method(s) planned, inspection scope, etc.)?
- If any inspections performed have indicated the presence of flaws or you have confirmed leakage, what actions have you taken to address these findings?

Table 1 summarizes the responses to these questions.

Attachment 1
CE Plant Pressurizer Heater Sleeve Inspection Information

TABLE 1

	PV-1,2,3	CC-1,2	MP-2	ANO-2	WSES-3	SL-1,2	PAL	Ft. Calhoun	SONGS-2,3
What inspections are you currently performing and method?	BMV, all sleeves, every RFO	BMV, all sleeves, every RFO	BMV, all sleeves, every RFO	BMV, all sleeves, every RFO	BMV, all sleeves, every RFO	BMV, all sleeves, every RFO, insulation not removed (see notes)	Visual, all sleeves, every RFO, insulation not removed	Visual, all sleeves, every RFO, insulation not removed	BMV, all sleeves, every RFO
What inspections are planned and method?	Continue with current practice	Continue with current practice	Continue with current practice	Continue with current practice	Continue with current practice	New inspections will include BMV, all sleeves, every RFO with insulation moved, or removed to view the heater sleeve penetration and the bare metal interface. Any leaking penetration will be investigated by NDE methods.	Continue with current practice	Continue with current practice	Continue with current practice
What are your plans to replace sleeves or PZR?	Completed ½ nozzle replacement of all Alloy 600 sleeves with Alloy 690 material on Unit 2 pressurizer in fall 2003. Plan the same replacements on Units 1 and 3 pressurizers by 2007.	Replaced U2 sleeves w/ Alloy 690 in 1989. Ni plated U1 sleeves in 1994.			Presently evaluating repair alternatives with intention to commence repairs during the next RFO	Ni plated SL-1 in 1997. Long term repair options for SL-1 and 2 are being evaluated.		Will replace pressurizer in 2006 using 316 Stainless steel sleeves	SCE is evaluating industry failure rates and recommendations to determine if new corrective measures are warranted at SONGS Units 2 and 3

BMV = Bare Metal Visual Inspection
RFO = Refueling Outage

NOTES:

Palo Verde (PV-1, 2, 3)
No notes provided.

Calvert Cliffs (CC-1,2)
Calvert Cliffs performs a bare metal visual examination of every penetration, every refueling outage.

Unit 2 at Calvert Cliffs has had all of the heater sleeves and upper instrument nozzles replaced with Alloy 690 material in 1989. The attachment welds used to attach the new nozzles were made with Alloy 82. All penetrations are currently examined by bare metal visual examination every refueling outage. Prior to replacement, one instrument nozzle and at least 20 heater sleeves on the Unit 2 pressurizer had experienced leakage. After replacement one instrument nozzle experienced leakage. The leakage on that one nozzle occurred through the attachment weld. That location was repaired by installing a new nozzle with a new attachment weld. The lower and mid level nozzles on the Unit 2 pressurizer are the original nozzles, and have been modified with Mechanical Nozzle Seal Assemblies so that in the event PWSCC occurred, there would be no possibility of leakage or degradation of structural integrity.

Unit 1 at Calvert Cliffs has had nickel plating applied to the inside diameter of 118 heater sleeve nozzles. The nickel plating was applied to isolate the heater sleeve surfaces from reactor coolant, which eliminates the possibility of primary water stress corrosion cracking. The outside diameter of the sleeves and the J-groove welds were not plated. During the outage when the plating was applied, two nozzles were found to be leaking. Another heater sleeve was abandoned during this outage due to a mechanical problem with a heater. All three of these locations were plugged with Alloy 690 plugs welded in place with Alloy 52 weld metal. During the plating process all sleeves were boroscopically examined on the inside diameter. Additionally, eddy current examination was performed on 10% of the sleeves with no indications identified. In 1998 one of the nickel plated sleeves was found to be leaking. That sleeve was removed for analysis, and the location plugged with an Alloy 690 nozzle welded in place with Alloy 52 weld metal. The cause of the leak was not unambiguously determined, but was speculated to have been due to fatigue failure of the plating over a defect that had existed prior to plating. PWSCC was speculated to have occurred at the location of the postulated pre-existing defect. The instrument nozzles on the Unit 1 pressurizer are original and have not experienced leakage. These nozzles have been modified by installation of mechanical nozzle seal assemblies that will prevent leakage and loss of structural integrity in the event the Alloy 600 base material is attacked by primary water stress corrosion cracking. Calvert Cliffs plans to periodically disassemble a sampling of mechanical nozzle seal assemblies to determine the condition of the underlying Alloy 600 material.

Mechanical nozzle seal assemblies have not been installed on any leaking nozzles at Calvert Cliffs. They have been installed on all but four of the pressurizer instrument nozzles in both pressurizers. The four nozzles that do not have MNSAs installed are Alloy 690 nozzles.

Millstone-2 (MP-2)

Millstone Unit 2 started doing bare metal visual (BMV) inspections of all 120 pressurizer heater sleeves during the Spring 2002 refueling outage and continued in the Fall 2003 refueling outage. Millstone-2 plans to continue this practice in the future. A section of insulation around the surge line was removed to gain access. The penetrations in the vicinity of the surge line were viewed directly and the remaining penetrations were viewed with the use of a borescope. The borescopic examination of the heater sleeves covers the full 360 degrees of the sleeve.

Both the Spring 2002 and the Fall 2003 BMVs discovered two leaking heater sleeves each. NDE of the leaking heater sleeves was done during Fall 2003 BMV. Inspection results are summarized in the table below. All of the indications were axial with most being below the weld. One or two were above the weld. A MNSA has been installed on all four leaking heater sleeves. No further action during the Fall 2003 refueling outage is currently planned.

Penetration Number	Outage Identified	Indication No.	Indication Orientation	Indication Length, Inches	Indication Depth, Inches	UT Wastage Noted
A1	2R14	1	Axial	0.362	0.125 TW	No
A1	2R14	2	Axial	0.185	0.130 TW	No
C3	2R15	1	Axial	0.326	0.122 TW	No
C3	2R15	2	Axial	0.330	0.122 TW	No
C3	2R15	3	Axial	0.318	0.123 TW	No
C3	2R15	4	Axial	0.251	0.123 TW	No
C3	2R15	5	Axial	0.360	0.123 TW	No
C4	2R14	1	Axial	0.379	0.126 TW	No
F4	2R15	1	Axial	0.358	0.121 TW	No

TW – through wall

ANO-2

ANO 2 Outage 2R16 (September 2003)
Inspection of the pressurizer heater sleeves was performed per procedure 2311.009. This inspection consisted of direct visual inspection with the insulation removed. The results of this inspection showed that there was no evidence of leakage from any heater sleeve penetration.

However, the inspection revealed slight leakage of one heater sleeve penetration (C-2) that had been repaired by installation of a MNSA2 (Mechanical Nozzle Seal Assembly 2) in 2R15. Investigation of this leakage determined that the leak occurred because of an installation error associated with field machining the counter bore for the MNSA2. This was subsequently resolved during 2R16.

Since there were no new leaks and historical leaking nozzles have been detected with no adverse concerns, non-destructive examination was not performed on any pressurizer heater penetration in 2R16.

ANO 2 Outage 2R15 (April 2002)
Direct visual examination of all heater sleeve penetrations with the insulation removed detected RCS leakage in six penetrations. MNSA2 seal assemblies were installed for the repairs. Non-destructive examination was determined to be unnecessary for any leaking heater sleeve or for any non-leaking heater sleeve.

ANO 2 Outage 2P2K (July 2000)
Direct visual examination of all heater sleeve penetrations with the insulation removed detected RCS leakage in twelve penetrations. (The root cause analysis report states that this was the first time in several years that the insulation had been removed from the pressurizer lower head.)

Eddy current examination (ECT) was conducted on three heater sleeves that exhibited leakage. Foreign material in the sleeves prevented ECT of the full length of the sleeves. Also approximately one inch of the sleeve top could not be examined due to stalling of the probe in the sleeve. ECT results indicated that there was a single through-wall axial crack in two sleeves below the J-groove weld that joined the sleeve to the cladding on the ID of the pressurizer. The cracks were close to the heat affected zone of the J-groove welds, although exact distance could not be determined. For the third sleeve, ECT was not successful in examining the weld area where the crack was suspected.

Repairs consisted of plugging the twelve leaking heater sleeves.

Heater Sleeve Inspections in Outages from 1988 to 2000

Heater sleeve inspections were performed during all outages from about 1988 to 2000. Inspections were normally visual examination using a flashlight and inspection mirror in the space between the insulation and vessel shell. Generally, all heater sleeves were inspected in each outage. No non-destructive examination was conducted. Leakage was not detected in any heater sleeve during this time period.

Outage in April 1987
Heater sheaths failed electrically and then by rupture in two heater sleeve penetrations. These failures subsequently caused cracking and leakage in one heater sleeve, but not in the second. The other heater sleeves were visually inspected without removal of the insulation. Non-destructive examination was not performed. The two leaking heater sleeves were plugged.

During the next outage (Spring 2005) and during future outages until permanent repairs are made, all heater sleeve penetrations and MNSA2 seal assemblies will be inspected by direct visual examination per procedure 2311.009. This is the same inspection method that was employed in September 2003.

<u>Waterford-3 (WSES-3)</u>
A sampling of the pressurizer heater sleeves have been inspected since 1992. These were bare metal visual inspections performed by engineering whenever heater elements were replaced. A 100 percent bare metal visual inspection of all pressurizer heater sleeves and instrument nozzles has occurred since the Spring of 1999. Two instrument nozzles were discovered leaking in the Spring of 1999 and they were repaired using the half nozzle weld repair. One leaking heater sleeve was discovered leaking in October of 2000 and it was plugged with a weld repair. Two heater sleeves were discovered leaking in October of 2003 and they were repaired with the MNSA2 seal assembly. NDE was performed for the first time in October of 2003 on two leaking heater sleeves, which revealed a single axial indication in each heater sleeve adjacent to the attachment weld.

1. What visual or NDE inspections you have performed on your pressurizer heater sleeves. Please include method(s) used, whether insulation was removed or not, and how any bare metal inspections were performed (direct visual access, boroscope, other).

<u>W3 RF-12 Spring of 2003</u>
Bare metal inspection of all pressurizer small bore Alloy 600 instrument nozzles and heater sleeves was performed. This inspection consisted of direct 360 degree visual inspection with the insulation removed. The results of this inspection revealed that there was evidence of leakage from heater sleeves C-1 and C-3 only. On those two sleeves the heater elements were removed and additional NDE was performed from the I.D. of the sleeve. This examination included both UT and ECT using the rotating Wesdyne 7010 probe. The results of these examinations indicated a single thru-wall axial flaw in each sleeve. These flaws were each located in the

region of the j-groove attachment weld, and extended outward toward the OD of the sleeve. The MNSA-2 seal assembly was used to repair both sleeves.

W-3 RF-11 Spring of 2002

Bare metal inspection of all pressurizer small bore Alloy 600 instrument nozzles and heater sleeves was performed. This inspection consisted of direct 360 degree visual inspection with the insulation removed. The results of this inspection revealed that there was no evidence of leakage from any nozzle or sleeve.

W-3 RF-10 Fall of 2000

Bare metal inspection of all pressurizer small bore Alloy 600 instrument nozzles and heater sleeves was performed. This inspection consisted of direct 360 degree visual inspection with the insulation removed. The results of this inspection revealed that there was evidence of leakage only from heater sleeve F-4. The heater element was removed and a welded plug was installed to repair this sleeve.

W-3 RF-9 Spring of 1999

Bare metal inspection of all pressurizer small bore Alloy 600 instrument nozzles and heater sleeves was performed. This inspection consisted of direct 360 degree visual inspection with the insulation removed. The results of this inspection revealed that there was evidence of leakage only at two of the top pressurizer instrument nozzles and they were weld repaired with the half nozzle repair.

W-3 Prior to RF-9

Previous inspections were preformed by Design Engineering as opportunities became available but no evidence of leakage was observed.

2. What are the plans for performing future inspections (please indicate when you plan to perform your next heater sleeve inspection, method(s) planned, inspection scope, etc.)

During the next outage (Spring 2005) and during all future outages until permanent repairs are implemented, all heater sleeve penetrations, small bore instrument nozzles, and any installed MNSA2 seal assemblies will be inspected by direct, bare metal visual examination.

3. If any inspections performed have indicated the presence of flaws or you have confirmed leakage, what actions have you taken to address these findings?

Attachment 1
CE Plant Pressurizer Heater Sleeve Inspection Information

The response to Question 1 discusses the actions, including repairs that were taken to address leaking pressurizer heater sleeves.

St. Lucie (SL-1,2)

The St Lucie Unit 1 and 2 Alloy 600 pressurizer heater sleeves and instrument nozzles have received a bare metal visual examination every refueling outage since 1990. Insulation was not removed from around the heater sleeves since the blanket insulation has gaps at every location leaving bare metal exposed at two quadrants 180° apart at each heater sleeve location. Going forward, visual inspections of the heater sleeves will be bare metal visual with the insulation either moved, or removed to gain access to the bare metal around each heater sleeve penetration. These inspections will be performed every RFO.

A complete bare metal visual inspection was performed in 1997 for SL-1 when all the insulation was removed to nickel plate the ID bore of the 120 heater sleeves.

Palisades (PAL)

1. Visual inspection performed every refueling outage. Insulation not removed.

2. Visual inspections will continue to be performed each refueling outage (in mode 3 at start and end of outage). Insulation not removed. No NDE inspection planned.

3. No through-wall leaks have been detected from visual inspection to date.

This was provided by PCS System Engineer, J Paulsen, and confirmed by Palisades ISI and MSC reps.

Ft. Calhoun

1. Fort Calhoun performs 100% visual examination immediately prior to plant shutdown and during hot system pressure testing.

2. Current plans are to perform the same 100% visual (with insulation not removed) in 2005 and then the PZR will be replaced in 2006 with 316 stainless steel nozzles and welds.

3. No leakage has been found in any of the PZR sleeves. Fort Calhoun is a participating member of the group with access to CE MNSAs, if any leakage was found, a temporary MNSA would be installed. An inventory of four MNSAs is available to Fort Calhoun.

Attachment 1
CE Plant Pressurizer Heater Sleeve Inspection Information

SONGS-2, 3

1. What visual or NDE inspections have you performed on your pressurizer heater sleeves? Please include method(s) used, whether insulation was removed or not, and how any bare metal inspections were performed (direct visual access, borescope, other).

SONGS performs direct visual inspections of the bare metal surface 360° around the crevice between each heater sleeve and the pressurizer (BMV, 100%, 360°, every RFO). Bare metal visual inspections at SONGS Units 2 and 3 do not require removal of insulation because there is an opening around each heater sleeve large enough to view the heater sleeve penetration at the pressurizer bottom head surface. In 1999, SONGS performed eddy current testing of the inside diameter (ID) of one pressurizer heater sleeve in which a heater was stuck.

2. What are the plans for performing future inspections (please indicate when you plan to perform your next heater sleeve inspection, method(s) planned, inspection scope, etc)?

The next heater sleeve inspections will be BMV, 100%, 360° during the next refueling outages, spring 2004 at Unit 2 and Fall 2004 at Unit 3. Eddy current inspections of the ID surface of pressurizer heater sleeves are planned to be performed if heaters are removed or if heater sleeve leakage is identified.

3. If any inspections performed have indicated the presence of flaws or you have confirmed leakage, what actions have you taken to address these findings?

At SONGS Unit 3, in spring, 1999, one heater sleeve ID was inspected using eddy current because the sleeve had become stuck in the sleeve. An axial indication was identified and it was estimated to be 40% through-wall. An Alloy 690 half sleeve repair was installed to prevent the possibility of pressure boundary leakage from that heater sleeve.